Marshall Star, January 18, 2012 Edition

MARSHALL STAR

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NASA's First J-2X Engine Rockets Through First Round of Testing; Development Continues Strong in 2012

By Amie Cotton

Using advanced technology, engineering processes and design, engineers at the Marshall Space Flight Center along with teams from NASA's Stennis Space Center and Pratt & Whitney Rocketdyne in Canoga Park, Calif., are setting new records in rocket engine development with the first J-2X engine unit, dubbed E10001.

Image right: Engineers and technicians in the A-2 Test Control Center at NASA's Stennis Space Center monitor activities during a November 2011 test of a next-generation J-2X rocket engine. (NASA/SSC)

The J-2X engine -- highly efficient and versatile -- is a key component of the Space Launch System's upper stage and will propel the nation's new heavy-lift launch vehicle beyond low-Earth orbit.

During 2011, E10001 rocketed through its first 10 tests probing engine performance and accumulated a total hot-fire test run time of 1,040 seconds at NASA's Stennis Space Center.

"E10001 got to 100 percent power in just four tests and achieved a full flight-duration test of 500 seconds in its eighth test -- quicker than any other U.S. engine program in history," said Tom Byrd, J-2X engine lead in the SLS Liquid Engines Office at Marshall. "That provides a tremendous cost savings to the Space Launch System Program. It also validates that our design is solid and allows us to move farther in engine development quicker."

In this first year of testing, the J-2X team focused on characterizing basic components' performance, understanding integrated engine system performance during prestart, start, full power operation and shutdown, as well as demonstrating full mission duration.

New engineering processes, along with design, analysis and development advances gleaned from numerous previous programs, have provided the J-2X engine team with a solid foundation to design, build and test the engine.

For example, the first J-2X engine has demonstrated high initial quality through manufacturing and assembly. High initial quality avoids costly and time-consuming re-works and re-designs that have historically typified building large engines. "For the J-2X engine, we've brought together a great suite of analytical models for loads, tolerances, structural integrity and assembly sequence," said Byrd. "Truly, we had little to no surprises assembling the E10001 test engine -- the components fit together like a glove -- and proved this new way really works for designing an engine."

Modern engineering tools and processes also enable a considerably shorter, more focused test schedule, saving a great deal of cost and time. The J-2X is totally redesigned from the heritage J-2 engine that flew humans to the moon in the 1960s and 1970s. And yet, over the coming years, the J-2X engine test program will need only 5 percent the number of tests required to develop the original J-2 engine. That's about 150 tests now versus about 3,000 then. The engineers who successfully got humans to the moon years ago clearly knew what they were doing, but today's engineers are equipped with all sorts of modern engineering tools, processes and lessons from the past -- and the SLS Program is the beneficiary in terms of an affordable engine development test program.

Byrd noted that this year's testing wasn't all smooth sailing. For example, a seal in the J-2X main oxidizer valve cracked and had to be replaced. The crack occurred because post-test operations did not adequately purge out the propellants in the engine main injector, leading to a "pop" after some tests, which damaged the seal. No other engine parts were damaged. The "pop" was eliminated by extending the duration of a post-test injector purge, which takes longer to clear out the propellants in the test configuration on the ground than in space. This was a relatively simple fix and the J-2X test program continued on.

Looking ahead, the team is geared up to test the engine's powerpack: the gas generator, oxygen and fuel turbopumps and related ducting and valves. This testing series will push the various components to operate over a wide range of conditions to ensure part integrity, demonstrate margin and better understand how the turbopumps operate.

In addition, the team will add a nozzle extension to the E10001 engine and make associated test stand modifications to see how the engine will perform at simulated altitude conditions where the atmospheric pressure is lower than on the ground. The J-2X is the second stage engine for the SLS heavy lift vehicle, so it starts and runs at altitude during flight.

In summer 2012, a new engine -- E10002 -- will be assembled and tested followed by a third engine, E10003, in 2013. A fourth engine will be assembled and tested in 2014.

"We'll continue to learn as we test, making incremental improvements to the new fleet of engines powering humans to new destinations like the moon, Mars and beyond," Byrd added.

For more information on the J-2X engine, visit http://www.nasa.gov/mission_pages/j2x/index.html.

For more information on the Space Launch System, visit http://www.nasa.gov/exploration/systems/sls/.

Cotton, an AI Signal Research Inc. employee, supports the Office of Strategic Analysis & Communications.

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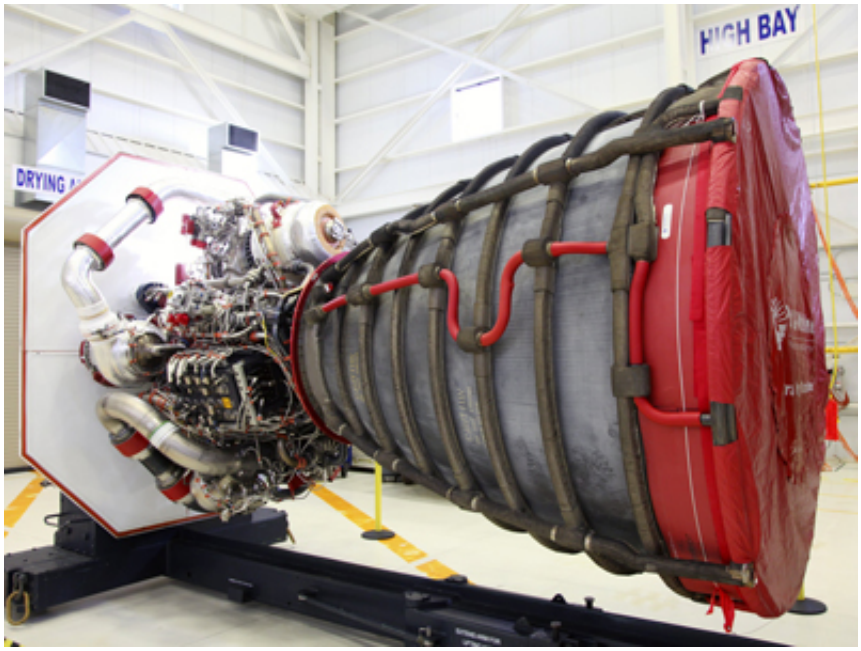
NASA Moves Shuttle Engines From Kennedy to Stennis

By Sanda Martel



The relocation of the RS-25D space shuttle main engine inventory from Kennedy Space Center's Engine Shop is under way. The RS-25D flight engines, repurposed for NASA's Space Launch System, are being moved to NASA's Stennis Space Center.

Image left: A RS-25D engine in the Engine Processing Facility at Kennedy is awaiting placement in a transportation canister for shipment to Stennis. (NASA/KSC)

The Space Launch System is a new heavy-lift launch vehicle that will expand human presence beyond low-Earth orbit and enable new missions of exploration across the solar system. The Marshall Space Flight Center is leading the design and development of the Space Launch System for NASA, including the engine testing program. SLS will carry the Orion spacecraft, its crew, cargo, equipment and science experiments to destinations in deep space.

"The relocation of RS-25D engine assets represents a significant cost savings to the SLS Program by consolidating SLS engine assembly and test operations at a single facility," said William Gerstenmaier, NASA's Associate Administrator for Human Exploration and Operations Mission Directorate.

The RS-25Ds -- to be used for the SLS core stage -- will be stored at Stennis until testing begins at a future date. Testing is already under way on the J-2X engine, which is planned for use in the SLS upper stage. Using the same fuel system -- liquid hydrogen and liquid oxygen -- for both core and upper stages reduces costs by leveraging the existing knowledge base, skills, infrastructure and personnel.

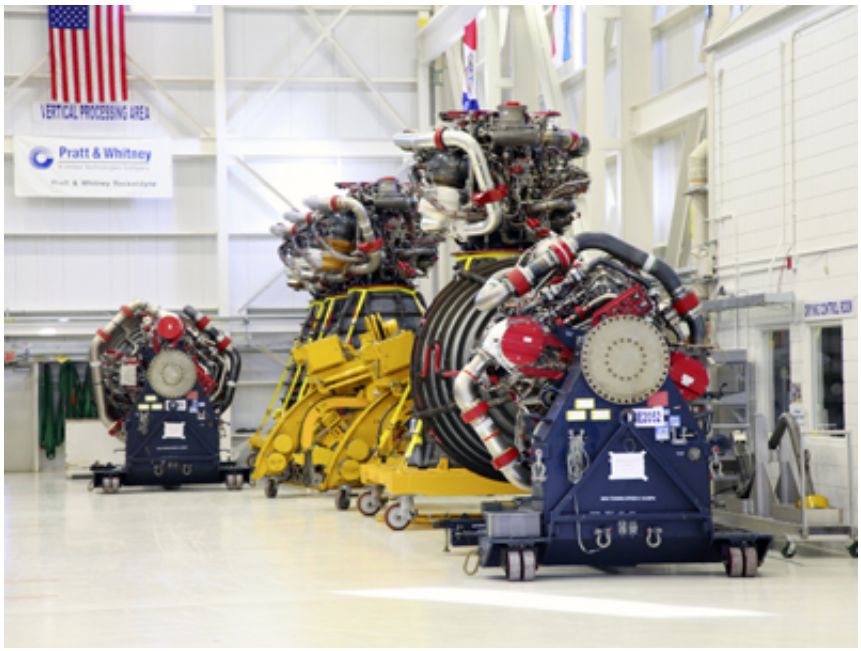


Image right: RS-25D engines line the wall of the Engine Processing Facility at Kennedy. Credit: (NASA/KSC)

"This enables the sharing of personnel, resources and practices across all engine projects, allows flexibility and responsiveness to the SLS program, and it is more affordable," said Johnny Heflin, RS-25D core stage engine lead in the SLS Liquid Engines Office at Marshall. "It also frees up the space, allowing Kennedy to move forward relative to commercial customers."

The 15 RS-25D engines at Kennedy are being transported on the 700-mile journey using existing transportation and

processing procedures that were used to move engines between Kennedy and Stennis during the Space Shuttle Program. They will be relocated one at a time by truck.

Built by Pratt & Whitney Rocketdyne of Canoga Park, Calif. the RS-25D engine powered NASA's space shuttle program with 100 percent mission success.

Image left: Technicians oversee the installation of a Pratt & Whitney Rocketdyne RS-25D engine into a transportation canister Jan. 12 in the Engine Processing Facility at Kennedy. (NASA/KSC)

For more information about SLS, visit http://www.nasa.gov/sls.

Martel, an AI Signal Research Inc. employee, supports the Office of Strategic Analysis and Communications.

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132 Marshall Civil Service Employees Retire

As of Jan. 3, 132 civil service employees have retired from the Marshall Space Flight Center during the last year. We honor them for their service and greatly appreciate their efforts and accomplishments.

James Adams Jr.
Dorothea Y. Aldredge
Melanie Aldridge
Ralph H. Allen
Bernard Anderson
Robert C. Armstrong
Sherman Avans
Douglas G. Bateman
Shirley R. Blair
Carol Blalock
Norma Bolander
Henry Brewster
Rita Brock
Sandra A. Brown
Shirley Buford
Donnie Burch
Gregory Burns
John R. Bush
Byron Butler
Lillian Campbell
Connie K. Carrington
Jerome B. Collins
Stephen Cushman

Sarah F. Datcher
Dennis Davis
Wm. Dehollander
Linda Dinges
Alice Dorries
Dr. James F. Dowdy
Linda S. Dunivant
Flavious Dutton
Suzanne M. Ellis
Rosemary Finley
Dr. Frank Fogle
Jonathan Folsom
Carlton Foster
Dennis C. Foster
Maytha Frankford
Gene E. Fundum
Patricia Fundum
John O. Funkhouser
Anita Garner
Peggy Geddings
Judy Glenn
Benny Graham
Johnny P. Griffin
James Grisham
Barbara Hambrick
Wayne Thomas Harmon
James H. Harper
David C. Harris
Phillip Harrison
Charles Henderson
John E. Hengel
Evelyn Hill
Elizabeth J. Holland
Nancy Jill Holland
Richard B. Hoover
Dolores Huber
Ricky H. Humphries
Bennie Jacks
Curtis Jackson
Jimmie E. Johnson
David T. Jones
Marshall Joy
Michael Karigan
Sarah Kent
John Key
Sarah T. Knight
Inge Kuberg
Lois Kuespert
Linda G. Lang
Young-Ching Lee
Dr. Sandor Lehoczky

Freddy W. Leslie
Teresa Lollar
Deborah Longeddy
Larry N. Lott
Roena Love
Kathleen Lundy
Polly Madden
Louis C. Maus
Joseph McConnell
Michael Mclean
Ann Mcnair
Rajinder S. Mehta
Pattie Miller
Sheila P. Moore
Diana Nelms
Jerald D. Oakley
Robert Osterblom
James Owen
Valerie Parker
Patsy Parmer
Thomas Reed
Robert C. Richmond
Edwin G. Ricks
Thomas Rieckhoff
Pamela Riley
Amanda Roberson
Debra Rodriguez
Michele E. Roeske
Steven E. Roy
David A. Schaefer
Harry Schramm
Marie L. Semmel
Barbara Shannon
Robert B. Shepard III
Alisa Shivers
Charles H. Shivers
Louis C. Simeone
Linda Smartt
David L. Sparks
David Stephenson
Carole Sullivan
Peter Sulyma
Freda Summers
John P. Sumrall
John D. Suter
Charlotte Talley
Ronald Tepool
Azona Terrell
Steve M. Tesney
Thomas A. Torres
David Trice

Larry D. Turner
May Wales
Gayla C. Warren
Tommy R. Watts
Danny Weldon
Ronald White
Tyrus M. White

Read Marshall Director Robert Lightfoot's tribute to these employees in his recent Director's Corner at http://www.nasa.gov/centers/marshall/about/star/star111221.html.

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NASA's Chandra Finds Largest Galaxy Cluster in Early Universe
NASA news release

An exceptional galaxy cluster, the largest seen in the distant universe, has been found using NASA's Chandra X-ray Observatory and the National Science Foundation-funded Atacama Cosmology Telescope, or ACT, in Chile.

Image right: A composite image shows El Gordo in X-ray light from NASA's Chandra X-ray Observatory in blue, along with optical data from the European Southern Observatory's Very Large Telescope in red, green and blue, and infrared emission from the NASA's Spitzer Space Telescope in red and orange. (X-ray: NASA/CXC/Rutgers/J. Hughes et al; Optical: ESO/VLT & SOAR/Rutgers/F. Menanteau; IR: NASA/JPL/Rutgers/F. Menanteau)

Officially known as ACT-CL J0102-4915, the galaxy cluster has been nicknamed "El Gordo" ("the big one" or "the fat one" in Spanish) by the researchers who discovered it. The name, in a nod to the Chilean connection, describes just one of the remarkable qualities of the cluster, which is located more than 7 billion light-years from Earth. This large distance means that it is being observed at a young age.

"This cluster is the most massive, the hottest, and gives off the most X-rays of any known cluster at this distance or beyond," said Felipe Menanteau of Rutgers University in New Brunswick, N.J., who led the study.

Galaxy clusters, the largest objects in the universe that are held together by gravity, form through the merger of smaller groups or sub-clusters of galaxies. Because the formation process depends on the amount of dark matter and dark energy in the universe, clusters can be used to study these mysterious phenomena.

Dark matter is material that can be inferred to exist through its gravitational effects, but does not emit and absorb detectable

amounts of light. Dark energy is a hypothetical form of energy that permeates all space and exerts a negative pressure that causes the universe to expand at an ever-increasing rate.

"Gigantic galaxy clusters like this are just what we were aiming to find," said team member Jack Hughes, also of Rutgers. "We want to see if we understand how these extreme objects form using the best models of cosmology that are currently available."

Although a cluster of El Gordo's size and distance is extremely rare, it is likely that its formation can be understood in terms of the standard Big Bang model of cosmology. In this model, the universe is composed predominantly of dark matter and dark energy, and began with a Big Bang about 13.7 billion years ago.

The team of scientists found El Gordo using ACT thanks to the Sunyaev-Zeldovich effect. In this phenomenon, photons in the cosmic microwave background interact with electrons in the hot gas that pervades these enormous galaxy clusters. The photons acquire energy from this interaction, which distorts the signal from the microwave background in the direction of the clusters. The magnitude of this distortion depends on the density and temperature of the hot electrons and the physical size of the cluster.

X-ray data from Chandra and the European Southern Observatory's Very Large Telescope, an 8-meter optical observatory in Chile, show that El Gordo is, in fact, the site of two galaxy clusters running into one another at several million miles per hour. This and other characteristics make El Gordo akin to the well-known object called the Bullet Cluster, which is located almost 4 billion light-years closer to Earth.

As with the Bullet Cluster, there is evidence that normal matter, mainly composed of hot, X-ray bright gas, has been wrenched apart from the dark matter in El Gordo. The hot gas in each cluster was slowed down by the collision, but the dark matter was not.

"This is the first time we've found a system like the Bullet Cluster at such a large distance," said Cristobal Sifon of Pontificia Universidad de Catolica de Chile in Santiago. "It's like the expression says: if you want to understand where you're going, you have to know where you've been."

These results on El Gordo are being announced at the 219th meeting of the American Astronomical Society in Austin, Texas. A paper describing these results has been accepted for publication in The Astrophysical Journal.

The Marshall Space Flight Center manages the Chandra program for NASA's Science Mission Directorate in Washington. The Smithsonian Astrophysical Observatory controls Chandra's science and flight operations from Cambridge, Mass.

For Chandra images, multimedia and related materials, visit http://www.nasa.gov/chandra.

For an additional interactive image, podcast and video on the finding, visit http://chandra.si.edu.

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March

Obituaries

John Henry McQuiston, 88, of Union Grove died Dec. 18. He retired from the Marshall Center in 1984 as an electronics technician. He is survived by his wife, Roberta Lenox Bowling McQuiston.

John Wesley Kaufman, 84, of Madison died Dec. 25. He retired from the Marshall Center in 1994 as an Earth sciences remote sensing engineer. He is survived by his wife, Marita Adams Kaufman.

John E. Glazner, 90, of Huntsville died Dec. 20. He retired from the Marshall Center in 1989 as an aerospace engineer. He is survived by his wife, Bettye Jo Glazner.

William Thomas Escue, 80, of Athens died Dec. 31. He retired from the Marshall Center in 1981 as an electronics engineer supervisor. He is survived by his wife, Brenda Johnson Escue.

Jerry Paul Hethcoat, 79, of Huntsville died Jan. 2. He retired from the Marshall Center in 1994 as an aerospace engineer. He is survived by his wife, Hilda Hethcoat.

Aubrey Sentell Drummond, 88, of Huntsville died Jan. 12. He retired from the Marshall Center in 1979 as an engineering technician.

Find this article at:

http://www.nasa.gov/centers/marshall/about/star/index.html